



Martin, N. D., & Davis, C. J. (2019). Evidence from masked-priming that initial identification of brand names is via abstract letter identities. *British Journal of Psychology*, 110(4), 745-768.
<https://doi.org/10.1111/bjop.12362>

Peer reviewed version

Link to published version (if available):
[10.1111/bjop.12362](https://doi.org/10.1111/bjop.12362)

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Evidence From Masked Priming That Initial Identification of Brand Names is via Abstract Letter Identities

Abstract

Although visual word recognition is often assumed to proceed on the basis of case-invariant letter representations, previous research has shown a role for letter case in recognising brand names. One recent study reported early effects of letter case in a brand decision task using masked primes (Perea, M., Jiménez, M., Talero, F., & López-Cañada, S. (2015). Letter-case information and the identification of brand names. *British Journal of Psychology*, 106(1), 162-173.). The present study attempts to replicate this finding using brand names typically presented in all lowercase (e.g., adidas), all uppercase (e.g., IKEA), or titlecase (e.g., Ford). Across three masked priming experiments we found no advantage for case-matched identity primes over case-mismatched identity primes. This finding suggests that brand-specific letter case information does not play a role in the early processing of brand names. However, we observed evidence that case may be used as a cue for making brand decisions, which may explain the effect reported by Perea et al. (2015).

Keywords: Brand-names, Letter-case, Lexical Decision, Masked-priming, Reading.

Many current theories of visual word recognition propose that words are identified on the basis of case-invariant abstract letter codes (e.g., Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Davis, 2010; Grainger, Rey & Dufau, 2008). These models specify a hierarchical arrangement of representations, with units that respond selectively to case-specific letter allographs (i.e., respond to ‘e’ but not ‘E’) found early in the hierarchy, and abstract letter units that respond on a case-invariant basis to allographs (i.e., same response to ‘e’ and ‘E’) found further up the hierarchy. In other words, although case-specific letter representations are selectively activated early in processing, words are identified on the basis of the activation of higher-level case-invariant letter units. Indeed, this theoretical approach is consistent with a long-standing theory concerning the role of abstract letter identities in visual word recognition (e.g., Allport, 1979; Coltheart, 1981; Evett & Humphreys, 1981; Rayner, McConkie & Zola, 1980). These are symbolic units that allow the system to abstract away from perceptually-specific variations in case, font and size when identifying words. In this way, words may be recognised through analytic processing of their component letters, with information about the visual form of a letter lost early in processing (Dehaene et al., 2004; McClelland, 1976; Perea & Rosa, 2002). (We shall refer to this theoretical approach as the *canonical account*).

However, there are challenges to the canonical account of word recognition. If words are identified purely on the basis of abstract letter units, identification should not be impeded by mIxEd-cASe presentation. Nevertheless, a mixed-case disadvantage has been reported in a wide variety of tasks, including perceptual identification, lexical decision, naming, semantic categorisation and passage reading (e.g., Allen, Wallace & Weber, 1995; Besner & McCann, 1987; Coltheart & Freeman, 1974; Kronbichler et al., 2009; Mayall & Humphreys, 1996; McClelland, 1976).

Other methods of disrupting the visual familiarity of words have demonstrated similar costs. For example, Perea and Rosa (2002) showed that alternating the font size of letters within words (e.g., g_ar_de_n) resulted in slower lexical decision latencies relative to standard presentation. In another experiment they found slower decision latencies for uppercase words than for lowercase words, which may also suggest a role for perceptual familiarity, given that readers encounter lowercase words more often than uppercase words (Perea & Rosa, 2002). On the face of it, each of these findings - the mixed-case cost, the alternating-size cost and the lowercase advantage - might be seen as posing a challenge to the canonical account, in which words are recognised via case (and size) invariant letter units. However, this challenge depends on when these effects occur. One response is to attribute such effects to a locus early in processing; for example, case-mixing could interfere with letter identification. However, a problem with this account is that the alternating-size cost and the lowercase advantage are not observed for nonwords.

An alternative way to reconcile visual familiarity effects in the lexical decision task with the canonical account is to attribute such effects to a post-access stage that occurs relatively late in processing (e.g., Besner, 1983; Kinoshita, 1987; Perea & Rosa, 2002). For example, the activation of a lexical representation may lead to an attempt to integrate a visual representation in long-term memory with the original sensory pattern. Detection of a mismatch could then delay a positive response. Alternatively, the mIxEd-cAsE or mIxEd-SiZe cost could simply reflect the late detection of the visual “strangeness” of the stimulus. One source of evidence for a late locus comes from reading experiments. Reingold, Yang and Rayner (2010) monitored participants eye movements whilst reading sentences. The sentences contained target word that were low or high frequency printed in either in lowercase or alternating case. On multiple

fixation trials, the duration of the first fixation was modulated by frequency but not case, suggesting that the case-alternation manipulation impacted later processing. A similar result was found by Perea, Rosa and Marcet (2017) who recorded eye movements whilst participants read sentences presented in lowercase or uppercase and containing a target word of high or low frequency. The results showed an overall advantage for reading lowercase over uppercase that was observed in gaze duration (i.e., the sum of first-pass fixation durations including refixations) but not first-fixation durations. Perea et al. concluded that the effect of case occurs after lexical access.

Evidence from masked priming. In order to investigate early processes in visual word recognition, researchers have often used a masked priming methodology (Forster & Davis, 1984; Jacobs & Grainger, 1991). Participants are shown a string of letters (the target) and asked to make a response such as a lexical decision. However, preceding the target, another string of letters (the prime) and a mask (typically a string of symbols e.g., #####) are briefly flashed on screen, typically for 30-60ms. Despite the fact that for most participants the prime remains virtually invisible and never reaches conscious awareness, the characteristics of the prime can impact response times to respond to the target. For example, participants are faster to make lexical decisions to a target word if it is preceded by a lowercase identity prime (e.g., table-TABLE) than if the prime has had two letters substituted (e.g., taghe-TABLE; Adelman et al., 2014; Forster, Davis, Schoknecht, & Carter, 1987; Perea & Lupker, 2003).

The masked priming paradigm has provided some of the strongest evidence for the canonical account of word recognition. For example, several experiments have shown no significant difference in response times between case-matched and case-

mismatched prime-target pairs (Forster & Davis, 1984; Jacobs, Grainger & Ferrand, 1995). This equivalence is observed both for visually similar (e.g., kiss-KISS) and visually dissimilar (e.g., edge-EDGE) mismatched pairs (Bowers, Vigliocco & Haan, 1998; Jacobs, Grainger & Ferrand, 1995; Perea, Jiménez & Gomez, 2014). More recently, Perea, Vergara-Martinez and Gomez (2015) reported that mixed-case identity primes were just as effective as same-case identity primes in a masked primed lexical decision task. This finding supports the canonical account in which there is a relatively late locus of the mixed-case cost. Further support for the canonical account was reported by Brysbaert, Speybroeck and Vanderelst (2009), who investigated processing of acronyms. Acronyms are of interest in this context because they are almost always presented in all uppercase letters (e.g., BBC, ISBN, MTV). Previous research showed that acronyms are processed more effectively when they are presented in their familiar uppercase format (Besner, 1984; Seymour & Jack, 1978). However, Brysbaert et al. (2009) found that the associative priming effects produced by acronym primes were equivalent in size for lowercase, mixed case and uppercase (e.g., isbn-BOOK, iSbN-BOOK, ISBN-BOOK). This finding suggests that the previous evidence for case-specificity effects in acronyms can be attributed to a late locus and provides further support for abstract models in which lexical representations are activated on the basis of abstract letter identities rather than their specific form.

Brand names. Although Perea, Vergara-Martinez and Gomez (2015) obtained evidence from masked priming in support of the canonical account of word identification, a separate masked priming experiment from the same lab appears to challenge this account. Perea, Jiménez, Talero and López-Cañada (2015) investigated processing of brand names. An interesting aspect of this category of words is that they typically appear in a specific visual form. For example, some brand names are typically

printed in lowercase (e.g., adidas, ebay, facebook), whereas others are typically printed in uppercase (e.g., IKEA, NIKE, SONY). Although a brand name's logo may be associated with other relevant visual features such as a specific font or colours, these features may not always be present when the brand name is used, whereas the specific case structure is likely to be used more generally, including in news articles, web-search results or underneath an app's icon on a smartphone. Perea, Jiménez, et al. (2015) took advantage of this aspect of brand names in order to provide a stringent test of the abstract account of word identification. In one experiment, they asked participants to perform a speeded brand decision task (i.e., brand or pseudo-brand). The results showed that familiar brand names were classified correctly more rapidly when they were presented in their standard case (e.g., adidas, IKEA) compared to their non-standard case (e.g., ADIDAS, ikea; see Gontijo et al., 2002 for related evidence). Perea, Jiménez, et al.'s (2015) finding indicates that participants encode the usual visual form of brand names, and that they make use of this representation when making brand decisions. However, it leaves open the possibility that this visually specific influence occurs post-access. That is, the stimulus ADIDAS may allow normal identification of adidas, after which the visually specific form is retrieved; a mismatch with the input stimulus at this point may then interfere with the correct response. The second experiment reported by Perea, Jiménez, et al. (2015) is more challenging for the abstract account, as it involves the masked priming paradigm discussed above, which is thought to specifically address the early stages of processing (e.g., Bowers, Vigliocco & Haan, 1998; Brysbaert, Speybroeck & Vanderelst, 2009; Forster & Davis, 1984; Perea, Vergara-Martinez & Gomez, 2015). In this experiment the brand name targets were always presented in their standard case and were primed by either a lowercase identity prime (adidas-adidas), an uppercase identity prime (ADIDAS-adidas), or an unrelated

brand name (e.g., FANTA-adidas). To minimise effects of physical overlap, a pattern mask was presented between the prime and target, which were presented in different sized fonts. The results showed a significant interaction of prime and target case. In particular, brand names that are typically presented in lowercase were responded to 29 ms slower, on average, when the prime was uppercase compared to when it was lowercase. It should be noted that this non-standard case disadvantage was not apparent for brand names that are ordinarily presented in uppercase. Nevertheless, Perea, Jiménez, et al. (2015) concluded that letter-case information forms part of a brand name's graphemic representation and that letter-case plays a role in the early processes of brand name recognition. This finding poses problems for the canonical account of visual-word recognition, which assumes that words are recognised exclusively on the basis of case-invariant abstract letter identities. However, the fact that the case-specific advantage was seen only for lowercase but not uppercase brands is hard to interpret in the light of current theories of word recognition (e.g., Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Davis, 2010; Dehaene et al., 2005; Grainger, Rey & Dufau, 2008).

The claim that letter-case influences the early stages of visual word processing for brand names is at odds with other related findings for non-brand names (e.g., Bowers, Vigliocco & Haan, 1998; Brysbaert, Speybroeck and Vanderelst, 2009; Forster & Davis, 1984; Jacobs, Grainger & Ferrand, 1995; Perea, Jiménez & Gomez, 2014). Perea, Jiménez, et al.'s (2015) evidence supporting the claim for early case effects is weak, in that it is inconsistent between uppercase and lowercase brands and the sample size is small. For this reason and given the ubiquity of the abstract letter account in current models of visual word identification, it is therefore appropriate to attempt to replicate Perea, Jiménez, et al.'s (2015) findings.

The present study. Experiment 1 is a direct replication of Perea, Jiménez, et al.'s Experiment 2 (2015). We used a masked prime brand-decision task to investigate the early stages of brand name recognition by comparing response times to brand name targets that were presented in their standard case and preceded by lowercase identity primes, uppercase identity primes and unrelated primes. Replicating Perea et al.'s reported interactions between the target case and prime case would support their claim of an early effect of case in brand name recognition. This would further challenge contemporary abstract models, which predict no interaction between the case of the prime and the target.

EXPERIMENT 1

METHOD

Participants. Sixty-three undergraduates participated in return for course credits. All had normal or corrected-to-normal vision and were native English speakers.

Stimuli and Design. The two independent variables were Target Case (uppercase vs lowercase) and Prime Type (uppercase identity prime, lowercase identity prime, or unrelated control prime). A set of 102 single-word brand names was collected, 51 of which are typically presented in all uppercase letters (e.g., IKEA, SONY etc; mean length of these items was 5.9 letters) and fifty-one that are in lowercase. The 'standard' presentation for the brand names used in each of the experiments in this article was based on the logo as it appeared on the brand's website in December 2015. Following Perea, Jiménez, et al. (2015), this condition included both strictly lowercase brands (e.g., adidas, ebay, etc, n=9) and brands in titlecase, in which an initial uppercase letter is followed by all lowercase letters (e.g., Audi, Ford, etc; n=42; mean length of

these items was 6.7 letters). (We explore possible differences between these lowercase categories in Experiments 2 and 3.) A set of 102 pseudo-brand names was created with the same orthographic structure and length as the brand names to serve as distractors in the task (e.g., utoy, Mandu's, SUBY). See Appendix A for a full list of stimuli.

The experimental manipulation factorially crossed Target Case with Prime Type, resulting in a total of 612 prime-target stimuli pairs, in which the prime was either: i) the same word as the target, in a matching case (e.g., SONY-SONY; ebay-ebay); ii) the same word as the target, in a mismatched case (e.g., sony-SONY; EBAY-ebay); iii) an unrelated brand or pseudo-brand, matched for length (e.g., utoy-SONY; IKEA-ebay; half in lowercase, half in uppercase). These 612 pairs were counterbalanced in a Latin square into three lists so that each of the 204 targets appeared on each list once (e.g., if the target 'SONY' was primed by 'SONY' in list 1, it would be primed by 'sony' in list 2, and an unrelated prime such as 'next' in list 3). Each list contained an equal number of primes from each condition. Participants were randomly assigned to one of the lists and thus saw all 204 target stimuli only once.

Procedure. The experiment was run on PsychoPy software (Peirce, 2007) to present stimuli and record responses. The procedure closely followed that of Perea, Jiménez et al. (2015). All trials proceeded as follows: A pattern mask (a series of #s, matched for target length) was displayed in the centre of the computer screen in 24-pt for 500 ms. The prime stimulus was then displayed in the centre of the screen in 20-pt for 33.3 ms. This was replaced by the pattern mask for 16.6 ms. The target stimulus was then presented in 24-pt until the participant had responded or until 2000 ms had passed. All stimuli were presented in Courier New font in white on a black background.

The experiment took the form of a brand decision task (i.e., ‘is it a real brand name?’). Participants were instructed to press the ‘M’ key if the target was a brand and the ‘Z’ key if the target was not a brand. Participants were instructed to respond as rapidly as possible while maintaining a high level of accuracy. There were seven practice trials (with feedback) before the experiment began. There were regular opportunities for breaks throughout the experiment. The experiment took approximately twenty minutes.

RESULTS

Prior to analysis we excluded participants who were excessively slow (greater than 2.5 SD from the sample mean RT) or error prone (accuracy below 75%). There was one participant who was error-prone and one participants who was much slower than the rest of the sample. Following the exclusions of participants there were 20 participants left in lists one and two and 21 participants in list three. We also excluded 13 items from the analysis where the mean accuracy for the item was below 75%. After exclusions there were 191 items remaining (96 brands and 95 pseudo-brands). Error responses (4.8% of trials) were excluded from the analysis of RT along with trials with RT faster than 250 ms or slower than 1500 ms (0.4% of trials).

Brand names. Table 1 shows the mean RT and accuracy for each brand name prime/target condition. These data were submitted to separate by-participant (F1) and by-item (F2) ANOVAs. The ANOVAs used a 2 (target case: lowercase, uppercase) x 3 (prime condition: lowercase, uppercase, unrelated prime) x 3 (list: list 1, list 2, list 3)

design. List was included as a dummy factor to remove error variance due to counterbalancing the lists. The ANOVA on correct RT showed a main effect of Prime Type, $F(2, 116) = 40.94, p < .001, \eta_g^2 = .061$; $F(2, 180) = 62.69, p < .001, \eta_g^2 = .11$, indicating that participants were quicker to respond to a brand name when it was preceded by an identity prime than an unrelated prime. There was no main effect of Target Case, $F(1, 58) = .01, p = .91, \eta_g^2 < .001$; $F(1, 90) = .00, p = .99, \eta_g^2 < .001$, and no interaction between Prime Type and Target Case, $F(2, 116) = .25, p = .78, \eta_g^2 < .001$; $F(2, 180) = .58, p = .56, \eta_g^2 < .001$. That is, the size of the priming effect was statistically equivalent for matched-case identity primes and mismatched-case identity primes (in all cases the priming effect was approximately 40 ms).

Analysis of error rates showed a main effect of Target Case, $F(1, 58) = 9.6, p < .01, \eta_g^2 = .013$, with fewer errors made for lowercase brands than uppercase brands, although this effect was not significant in the analysis by items, $F(1, 90) = 1.37, p = .25, \eta_g^2 = .010$. Analysis of error rates also showed a main effect of Prime Type, $F(2, 116) = 10.32, p < .001, \eta_g^2 = .042$; $F(2, 180) = 13.68, p < .001, \eta_g^2 = .042$, with fewer errors made for identity primes. There was no Prime Type x Target Case interaction, $F(2, 116) = 1.71, p = .19, \eta_g^2 = .006$; $F(2, 180) = 1.95, p = .15, \eta_g^2 = .006$.

The analysis above supports the conclusion that there is no interaction between prime case and target case for brand name priming. As a further test of this conclusion that we used the *BayesFactor* R package (Rouder, Morey, Speckman & Province, 2012) to evaluate the relative evidence in the data for models with and without an interaction term. The favoured model from this analysis was the one with only Prime Type as a factor; this model was preferred to the model that included Prime Type and Target Case and their interaction by a factor of over 1000 (BF ratio = $1334.5 \pm 2.94\%$). That is, the Bayesian analysis provides very strong evidence for the conclusion that brand name

identity priming in this experiment did not vary as a function of the correspondence of the case of the prime and target.

Pseudo-brands. Table 2 shows mean RT and accuracy for pseudo-brands. These data were analysed in the same way as the brand name data. For pseudo-brands, the ANOVA on correct RT showed no main effect of Target Case, $F(1, 58) = 2.81, p = .1, \eta_g^2 = .001$; $F(1, 89) = .6, p = .44, \eta_g^2 = .005$ or prime condition, $F(2, 116) = 1.26, p = .29, \eta_g^2 = .001$; $F(2, 178) = 1.17, p = .31, \eta_g^2 = .004$. However, the interaction between Target Case and Prime Type was significant, $F(2, 116) = 5.8, p < .01, \eta_g^2 = .006$; $F(2, 178) = 5.34, p < .01, \eta_g^2 = .016$. This reflects the fact that participants showed a 13 ms advantage in correctly rejecting lowercase pseudo-brands when they were preceded by a lowercase identity prime compared to an uppercase identity prime. Analysis of pseudo-brand errors showed a main effect of Target Case, $F(1, 58) = 19.99, p < .001, \eta_g^2 = .043$; $F(1, 89) = 5.6, p < .05, \eta_g^2 = .037$. There was no main effect of Prime Type, $F(2, 114) = .53, p = .59, \eta_g^2 = .003$; $F(2, 186) = .50, p = .61, \eta_g^2 = .002$, nor was there an interaction of the two factors, $F(2, 114) = .47, p = .63, \eta_g^2 = .002$; $F(2, 186) = .51, p = .60, \eta_g^2 = .002$.

DISCUSSION

The main finding of Experiment 1 is that statistically equivalent priming effects were found for brands names preceded by matched-case identity primes and mismatched case identity primes. We did not replicate the Target Case by Prime Case interaction for brand names that was reported by Perea, Jiménez, et al. (Exp 2, 2015). Thus, our results are consistent with the canonical account, according to which words

are recognised on the basis of abstract letter codes. This account appears to apply equally well to brand names, despite their use of standardised case formats.

There was some evidence for case-specific priming in the pseudo-brand targets. That is, participants were faster to correctly reject a lowercase pseudo-brand when preceded by a lowercase identity prime than by an uppercase identity prime. This phenomenon may be related to a similar observation that has been reported in a lexical decision task by Perea, Jiménez and Gómez (2014), who found that for pseudo-words, but not for words, matched-case identity PRIME–TARGET pairs were responded to faster than mismatched-case identity prime–TARGET pairs. A similar finding was also reported by Vergara-Martínez, Gómez, Jiménez and Perea (2015). The explanation of these case-specific identity priming effects for pseudo-words and pseudo-brands is not entirely clear, but presumably reflects non-lexical processing (we return to this issue in the General Discussion). Thus, the observation of this interaction for pseudo-brands does not modify our conclusion that recognition of familiar brands depends upon abstract letter units.

The results of Experiment 1 leave us with the question of why Perea, Jiménez, et al. found slower RTs for brand names preceded by mismatched case identity primes than matched case identity primes (e.g., slower response times to ADIDAS-adidas than to adidas-adidas). Perea, Jiménez, et al. observed this difference for lowercase brand names, but not for uppercase brand names, which raises the possibility that the effect they observed was simply a consequence of a Type I error resulting from a noisy estimate of a single condition: that in which lowercase targets are preceded by uppercase primes. As noted earlier, the items in this “lowercase” condition in Perea, Jiménez, et al.’s experiment (and in our replication of their experiment) can be further subdivided into two different categories: those in all lowercase (e.g., adidas, ebay) and

those in titlecase (e.g., Audi, Ford). In Experiment 2 we sought to explore this subdivision in order to investigate whether there was a difference between the lowercase and titlecase target conditions, and whether this might account for Perea, Jiménez, et al.'s observed effect. We also opted to present primes for a slightly longer duration than in Experiment 1, reasoning that this would provide greater opportunity for any effect of prime case to manifest itself.

EXPERIMENT 2

Experiment 2 used the same brand decision task as Experiment 1, with two changes. First, the prime duration was increased from 33 ms to 50 ms. Second, the lowercase condition of Experiment 1 was replaced by two separate conditions: all lowercase and titlecase. Thus, brands from three conditions were included: a) all lowercase (e.g., ebay, adidas, etc); b) titlecase (e.g., Audi, Ford, etc) and c) all uppercase (e.g., IKEA, SONY, etc).

[Footnote: We also included a fourth condition of 20 brands and corresponding pseudo-brands that used an unconventional case structure (e.g., iPlayer, GoPro, etc). However, since these brands are less common we were unable to find enough items to balance the conditions, and these items were not included in the analysis].

The brand decision task in this experiment was followed by a brand familiarity questionnaire to enable us to gather data on the relative familiarity of the brand names and its impact on RT and accuracy.

METHOD

Participants. Participants were recruited via university mailing lists and advertisements on social media. All had normal or corrected-to-normal vision and were native English speakers. One-hundred and twelve participants were tested.

Materials. A set of 120 single-word brand names was collected, including 79 items used in Experiment 1. Forty of these brands typically use an all lowercase format (e.g., adidas, ebay, etc; mean length: 6.5). Forty brands use titlecase structure, as is the convention for proper nouns in written English (e.g., Audi, Ford, etc; mean length: 7). Forty of the brands typically use all uppercase (e.g., IKEA, SONY, etc; mean length: 5.7). A set of 120 pseudo-brand names was created of the same orthographic structure and length as the brand names to serve as distractors in the task (e.g., utoy, Mandu's, SUBY, CyClo). See Appendix B for a full list of brands and pseudo-brands used.

The 240 brands and pseudo-brands served as target stimuli and were always presented in their standard case (e.g., ebay, Ford, SONY, easyJet). Each target was preceded by a prime that was either: i) the same word as the target, presented in all lowercase (e.g., sony-SONY; ebay-ebay; ford-Ford); ii) the same word as the target, presented in titlecase (e.g., Sony-SONY; Ebay-ebay, Ford-Ford); iii) the same word as the target, presented in all uppercase (e.g., SONY-SONY; EBAY-ebay, FORD-Ford); iv) an unrelated brand or pseudo-brand, matched for length, (e.g., SONY-Dove; ebay-IKEA; Ford-etoy). A total of 960 prime-target stimuli pairs were counterbalanced in a Latin square into four lists so that each of the 240 targets appeared on each list once. Each list contained an equal number of primes from each condition.

A separate list of 21 pseudo-brands was included in the brand familiarity questionnaire to serve as foils. These items were not included in the brand decision task.

Procedure. The experiment was run using DMDX software (Forster & Forster, 2003) to present stimuli and record response times and errors. The procedure was identical to Experiment 1, with the sole exception that the prime duration was increased to 50 ms in this experiment.

Following the brand decision task, participants were given a brand familiarity questionnaire which included the 120 brands from the brand decision task, along with the 20 atypical case structure brand names (e.g., iPlayer, GoPro, etc) and 21 pseudo-brands which were not included in the brand decision task, giving 161 items in total. The items appeared in a random order. All brand names were presented in their standard case. Participants were asked to rate how frequently they encountered each item in its written form on a scale of 0-3. The guidelines for the ratings were: 0 = I do not know this brand; 1 = I rarely see this brand name; 2 = I occasionally encounter this brand name; and 3 = I frequently encounter this brand name.

RESULTS

There were four participants whose mean RT was very slow (> 1000 ms and more than 2.5 SDs greater than the mean). These participants were excluded from the analysis. Following the exclusions of participants there were 27 participants left in each of the four lists. Twenty-two items with accuracy below 75% were excluded, and three items were recorded as missing due to experimenter error, leaving 215 items remaining (103 brands and 112 pseudo-brands). Error responses (5.4% of trials) were excluded

from the analysis of RT. RTs faster than 250 ms or slower than 1500 ms were also excluded from analysis. This resulted in the exclusion of 1.2% of trials.

Mean RT and accuracy were submitted to separate by-participant and by-item ANOVAs. The ANOVAs used a 3 (target case: lowercase, titlecase, uppercase) x 4 (prime condition: lowercase, titlecase, uppercase, unrelated prime) x 4 (list: list 1, list 2, list 3, list 4) design.

Brand names. Table 3 shows the mean RT and accuracy for each prime/target condition. Analysis of RT for brands showed a main effect of Prime Type, $F(3, 309) = 88.05, p < .001, \eta_g^2 = .040$; $F(3, 288) = 67.60, p < .001, \eta_g^2 = .105$ reflecting the fact that identity primes were associated with faster responses than unrelated primes. The by-participants ANOVA on RT showed a main effect of Target Case, with an advantage for uppercase brands, $F(2, 206) = 17.49, p < .001, \eta_g^2 = .011$; $F(2, 91) = 1.54, p = .22, \eta_g^2 = .030$. However, as in Experiment 1 we found no Prime Type x Target Case interaction $F(6, 618) = .9, p = .5, \eta_g^2 = .001$; $F(6, 288) = .7, p = .65, \eta_g^2 = .003$.

The by-participants ANOVA on error rates showed a main effect of Target Case which did not reach significance in the by-items analysis, $F(2, 206) = 20.56, p < .001, \eta_g^2 = .027$; $F(2, 91) = 2.75, p = .07, \eta_g^2 = .040$. There was no main effect of Prime Type on errors, $F(3, 309) = .99, p = .4, \eta_g^2 = .002$; $F(3, 288) = 1.02, p = .39, \eta_g^2 = .003$ and no Prime Type x Target Case interaction $F(6, 618) = .72, p = .64, \eta_g^2 = .002$; $F(6, 288) = .84, p = .54, \eta_g^2 = .005$.

Using the *BayesFactor* R package (Rouder et al., 2012), the favoured model to

fit our data was the one with Prime Type and Target Case as factors; this model was preferred to the model that included Prime Type and Target Case and their interaction by a factor of 5.8×10^5 .

Pseudo-brands. Table 4 shows mean RT and accuracy for pseudo-brands. Analysis of RT for pseudo-brands showed a main effect of Prime Type, $F(3, 309) = 20.56, p < .001, \eta_g^2 = .007$; $F(3, 315) = 17.15, p < .001, \eta_g^2 = .029$, with participants responding more quickly following an identity prime than an unrelated prime. There was no main effect of Target Case, $F(2, 206) = 1.91, p = .15, \eta_g^2 < .001$; $F(2, 100) = .19, p = .83, \eta_g^2 = .004$, nor was there a Prime Type by Target Case interaction, $F(6, 618) = 1.05, p = .39, \eta_g^2 < .001$; $F(6, 315) = 1.03, p = .41, \eta_g^2 = .004$.

For pseudo-brands, analysis of error rates showed a main effect of Target Case in the by-participant ANOVA, $F(2, 206) = 12.02, p < .001, \eta_g^2 = .018$; $F(2, 100) = 2.39, p = .1, \eta_g^2 = .035$ with no effect of Prime Type, $F(3, 309) = .6, p = .6, \eta_g^2 = .001$; $F(3, 315) = .55, p = .65, \eta_g^2 = .001$ and no Prime Type x Target Case interaction, $F(6, 618) = 1.21, p = .3, \eta_g^2 = .008$; $F(6, 315) = 1.0, p = .42, \eta_g^2 = .010$.

Brand familiarity questionnaire. Mean familiarity scores for each of the items in the questionnaire are shown in Table 5. A one-way ANOVA (Brand case: lowercase, titlecase, uppercase) on the 120 brands used in the analysis showed an effect of brand case $F(2, 117) = 183.17, p < .001$. Pairwise comparison showed that lowercase brands ($M = 1.86, SD = 1.03$) were significantly less familiar than uppercase ($M = 2.16, SD = .89, p < .001$) or titlecase ($M = 2.21; SD = .9, p < .001$) brands. Titlecase brands were

also significantly more familiar than uppercase brands ($p = .02$).

DISCUSSION

The results of Experiment 2 showed equivalent priming effects for all identity primes, regardless of prime case. That is, we again failed to replicate the interaction of prime and target case reported by Perea, Jiménez, et al. (2015, Experiment 2). The interaction did not approach significance, despite a relatively powerful test (our sample size was considerably larger than that of Perea, Jiménez, et al., 2015). Furthermore, the Bayes Factor analysis indicates that a statistical model with no interaction term fits is over 10,000 times more likely than a model with an interaction term. This result fits with predictions made on the basis of the canonical account.

There was, however, evidence of an effect of the target case of brand names, which was significant in the by-participant analysis, though not in the by-item analysis. Participants made the greatest number of errors and were slowest to respond to lowercase brands. This effect may simply reflect differences in familiarity, as seen in the brand familiarity questionnaire, in which participants rated the lowercase brands as significantly less familiar than the titlecase or uppercase brands.

As expected, the longer prime duration of 50 ms in Experiment 2 did lead to an overall increase in the effect of identity primes, relative to Experiment 1. For brands the average priming effect was 51 ms, an increase from Experiment 1 of 10 ms. For pseudo-brands there was a 25 ms effect of identity primes, compared to no significant effect in Experiment 1. In contrast to Experiment 1, though, there was no Prime Case by Target Case interaction for pseudo-brands in Experiment 2. Once again, the explanation of these identity priming effects for pseudo-brands is not entirely clear, but

presumably reflects non-lexical processing, and we defer further consideration of this issue until the General Discussion.

We are once again left with the question of why our findings differ from those reported by Perea, Jiménez, et al. (2015, Experiment 2). In this regard it is appropriate to note that the titlecase brands in Experiment 2 did show a numerical difference of 9 ms in the direction of a case-specific identity priming effect. It could be argued that this pattern is similar to that observed by Perea, Jiménez, et al. whose lowercase brand names were mostly made up of what we refer to here as titlecase brands. In both our experiment and Perea, Jiménez, et al.'s there was no indication of any case-specific priming for uppercase targets (we thank Manuel Perea, personal communication, 2nd January, 2018, for highlighting the similarity of this pattern).

We explored the titlecase target condition further in post-hoc analyses. The effect of an titlecase identity prime (relative to an unrelated prime) was 56ms compared to 48ms for an uppercase identity prime. Although this 8ms difference was not significant, we found that the difference between titlecase and uppercase primes increased to a significant 17 ms, $t(30) = 2.09$, $p = .046$, when we excluded brand names that are words in their own right ("Boots", "Nestle", "Dove", "Ford") or compounds of existing words ("Superdrug", "Microsoft"). One might reasonably argue that case-specific priming effects would be reduced for titlecase targets that regularly occur in lowercase. This left us with a nonsignificant 13 ms difference ($p = .25$) between titlecase and lowercase primes. However, we noted that the initial letter (which is the only difference between the titlecase and lowercase prime conditions) is very similar in its upper and lowercase forms for several of the remaining brand names (e.g., "Canon", "Fanta", "Shreddies"). Excluding these targets (those beginning with "C", "F", "S" or "W") increased the difference between titlecase and lowercase primes to 25 ms, which

approached significance, even with only 22 targets ($p=.08$). Clearly these post-hoc analyses must be treated with caution. Nevertheless, the possibility that there could be case-specific priming for titlecase brands under specific conditions offered the hope of reconciling our results with Perea, Jiménez, et al. (2015, Experiment 2), and therefore warranted a further experiment.

EXPERIMENT 3

Experiment 3 was a further masked-priming brand-decision task. Based on the post-hoc analysis of Experiment 2 described above, we excluded titlecase brands that are existing words in their own right (e.g. Dove) or compounds of existing words (e.g., Superdrug), reasoning that the tendency to encounter such items in lowercase form would reduce the likelihood of observing case-specific effects of their brand case. We also excluded titlecase brands that begin with a letter that is perceptually similar in lowercase and uppercase (this affected brands beginning with c/C, m/M, f/F, o/O, s/S, w/W and z/Z). The rationale for this exclusion was that the similarity of these letters would make differences between titlecase and lowercase primes difficult to detect (e.g., primes like Colgate vs colgate).

To compensate for the reduced number of brand targets we made two modifications to the experimental design used previously. First, we eliminated the unrelated prime condition. The brand identity priming effect was clearly established in Experiments 1 and 2 (and was previously shown by Perea, Jiménez, et al., 2015, Experiment 2). Rather than seeking to measure the size of this effect again, we focused our attention on the effect of prime case for identity primes. Second, we chose to repeat targets within the experiment, such that each participant saw each target three times, preceded by a lowercase, titlecase or uppercase identity prime. In this way, no counterbalancing of lists was required.

METHOD

Participants. Fifty-six native English-speaking participants with normal or corrected-to-normal vision were recruited via university mailing lists and advertisements on social media.

Materials. A set of 60 single-word brand names was selected from items used in Experiment 2, equally distributed across lowercase, titlecase and uppercase conditions. Brand names were selected to balance the familiarity of the three target cases, whilst minimizing the number of low familiarity items. The mean familiarity (based on ratings in Experiment 2 on a 4-point scale) for each condition was 2.29, 2.29, and 2.36 for the lowercase, titlecase and uppercase conditions respectively. For each brand name an equivalent pseudo-brand name was created with a similar orthographic structure and length. None of the pseudo-brands were existing legal words. See Appendix C for a full list of brands and pseudo-brands used in Experiment 3.

Procedure. The experiment was run using DMDX software (Forster & Forster, 2003) to present stimuli and record response times and accuracy. As with Experiments 1 and 2, brands and pseudo-brands were always presented in their standard case and served as targets in a brand decision task. Targets were preceded by an identity prime presented in either lowercase, titlecase or uppercase (e.g., google-Google, Google-Google or GOOGLE-Google). Prime stimuli were displayed for 50 ms. Each participant saw all 360 prime-target pairs once.

RESULTS

The median accuracy across participants was 95.2%, and all subjects had mean

accuracies greater than 84%. Five targets with accuracy below 75% were excluded, leaving 115 targets (58 brands and 57 pseudo-brands). Error responses (5.4% of trials) were excluded from the analysis of RT. Trials with RTs faster than 250 ms or slower than 1500 ms were also excluded from analysis (0.7% of trials were too slow). Mean RT and accuracy were submitted to separate by-participant and by-item ANOVAs. The ANOVAs used a 3 (target case: lowercase, titlecase, uppercase) x 3 (prime condition: lowercase, titlecase, uppercase) design.

Brand names. Table 6 shows the mean RT and accuracy for each prime/target condition. Analysis of RT for brands showed a main effect of Prime Case, $F(2, 110) = 4.97, p = .009, \eta_g^2 = .003$; $F(2, 110) = 3.65, p = .03, \eta_g^2 = .014$, with an advantage for titlecase primes over lowercase and uppercase primes. There was also a main effect of Target Case, $F(2, 110) = 27.09, p < .001, \eta_g^2 = .019$; $F(2, 55) = 3.16, p = .05, \eta_g^2 = .083$, with an advantage for uppercase targets over lowercase and titlecase targets. As in Experiments 1 and 2 we found no Prime Case x Target Case interaction, $F(4, 220) = 0.89, p = .47, \eta_g^2 = .001$; $F(4, 110) = 0.86, p = .49, \eta_g^2 = .006$. Analysis of error rates showed a main effect of Target Case, $F(2, 110) = 21.80, p < .001, \eta_g^2 = .073$; $F(2, 55) = 3.23, p = .047, \eta_g^2 = .089$ with fewer errors for uppercase than titlecase or lowercase targets. There was no effect of Prime Case, $F(2, 110) = 0.95, p = .39, \eta_g^2 = .003$; $F(2, 110) = 1.09, p = .34, \eta_g^2 = .003$ and no Prime Case x Target Case interaction, $F(4, 220) = 0.59, p = .67, \eta_g^2 = .003$; $F(4, 110) = 0.54, p = .70, \eta_g^2 = .003$.

Pseudo-brands. Table 7 shows mean RT and accuracy for pseudo-brands. Analysis of RT for pseudo-brands showed a main effect of Target Case in the by-

participants analysis $F(2, 110) = 10.20, p < .001, \eta_g^2 = .005$, with lowercase pseudo-brands responded to faster than titlecase or uppercase pseudo-brands; however, this difference was not significant in the by-items analysis, $F(2, 54) = 1.00, p = .38, \eta_g^2 = .028$. There was no main effect of Prime Case, $F(2, 110) = 0.10, p = .91, \eta_g^2 < .001$; $F(2, 108) = 0.10, p = .91, \eta_g^2 < .001$, and no Prime Case x Target Case interaction $F(4, 220) = 1.88, p = .12, \eta_g^2 = .002$; $F(4, 108) = 1.31, p = .27, \eta_g^2 = .010$. For pseudo-brands, analysis of error rates showed no main effect of Target Case, $F(2, 110) = 1.21, p = .3, \eta_g^2 = .003$; $F(2, 54) = 0.21, p = .81, \eta_g^2 = .006$ or Prime Case, $F(2, 110) = 0.67, p = .52, \eta_g^2 = .002$; $F(2, 108) = 0.85, p = .43, \eta_g^2 = .004$. There was no Prime Case x Target Case, $F(4, 220) = 0.36, p = .84, \eta_g^2 = .002$; $F(4, 108) = 0.49, p = .74, \eta_g^2 = .005$.

DISCUSSION

In Experiment 3 we found no interaction between Prime Case and Target Case, meaning that brand names were not classified significantly faster if preceded by a case-matched identity prime. However, there was a main effect of Prime Case, with participants responding fastest to all brands when preceded by a titlecase prime. One possible explanation is that participants used the case of the prime as a source of information relevant to the task. In English, names and other proper nouns are ordinarily capitalised (e.g., Chris, England) and thus participants may have used early detection of titlecase format as a cue that the stimulus was a name (in this case, a brand name). In addition to the titlecase prime advantage, further evidence that participants were using this strategy is seen in the pseudo-brand data. Participants were slowest to reject pseudo-brand targets presented in titlecase, suggesting that the detection of this (misleading) case cue pushed participants towards an incorrect Brand decision, slowing correct Pseudo-Brand decisions. The absence of a titlecase advantage for brand targets

may seem inconsistent with a decision strategy that uses titlecase as a cue. However, it must be recalled that the case of the brand targets was determined by the standard case associated with the brand, and thus comparisons across Target Case conditions may be confounded with other factors. In the case where targets are brands the factors associated with lexical retrieval of these targets may overwhelm early orthographic cues.

In summary, the results of Experiment 3 confirm our previous conclusion that there is no advantage for primes presented in the same case as targets, once again suggesting that the early processes in brand name recognition are similar to those in normal word recognition, depending in both cases on abstract letter codes. However, our results do show evidence of an effect of prime case. This finding is consistent with that observed by Perea, Jiménez, et al. (2015, Experiment 2) and with the numerical trend observed for titlecase targets in Experiment 2. Our interpretation of this effect of prime case, which supported by the data from the pseudo-brand targets, is that it is specific to the requirements of this task. When participants are asked to decide, as rapidly as possible, whether a target stimulus is a name (as opposed to a familiar letter string) they make use of orthographic cues that are ordinarily reliably associated with names.

GENERAL DISCUSSION

We conducted three masked primed brand decision tasks with prime durations of 33 ms and 50 ms. None of these experiments showed an interaction between prime case and target case for brand names, e.g., responses to the target ‘adidas’ were no faster following a lowercase identity prime (e.g., adidas-adidas) than the corresponding uppercase identity prime (e.g., ADIDAS-adidas). The evidence from our masked priming experiments is consistent with the standard account – what we have referred to as the canonical theory of visual word recognition – in which words are recognised on

the basis of abstract letter identities (e.g., Allport, 1979; Coltheart, 1981; Dehaene et al., 2005; Evett & Humphreys, 1981; Grainger et al., 2008; Rayner et al., 1980). This account predicts no influence of an identity prime's case on response times, since the advantage of such a prime over an unrelated prime is independent of case and due to the early activation of case-invariant letter representations which provide the basis for word identification. Perea, Jiménez, et al. (2015) suggested that this canonical account cannot explain recognition of all words, and in particular, that specific case information must play a role in the recognition of brand names. Such stimuli, like acronyms, have a specific case format, and therefore might be expected to show increased sensitivity to case, and perhaps be recognised on the basis of their whole word shape. The interaction between Prime Case and Target Case in Perea, Jiménez, et al.'s masked priming experiment appears to pose a problem for the canonical account. In this light, the absence of such an interaction in any of our experiments removes this problem, and is entirely consistent with previous research with non-brand stimuli that shows no early effect of case on word recognition (e.g., Bowers, Vigliocco & Haan, 1998; Forster & Davis, 1984; Jacobs, Grainger & Ferrand, 1995). Our results suggest that brand names are recognised in the same way as standard words.

Although we did not find support for Perea, Jiménez, et al.'s (2015) conclusion that case-specific representations are required for brand name recognition, we did obtain evidence that may help to explain their findings. As noted already, the interaction they observed was asymmetric: there was no evidence of case-specific priming for uppercase brand names, but there was evidence of greater priming for lowercase brand names primed by lowercase identity primes than uppercase identity primes. It is important to note that the majority of their "lowercase" brand names were stimuli in which all of the letters were in lowercase, except the initial letter, which was capitalised (i.e., titlecase,

as in brand names like Google). Our Experiment 2 showed a small numerical trend in the same direction as Perea, Jiménez, et al., with slightly faster responses for titlecase targets when they were preceded by titlecase primes than by upper (or all lower) case primes. The critical evidence comes from Experiment 3, in which we found an overall advantage for titlecase primes for all targets (i.e., no interaction with target case). Our explanation of this effect is that participants adapt to the brand name decision task by exploiting typographic cues that are ordinarily a reliable index of proper names.

The suggestion that participants exploit titlecase format to make brand name decisions is similar in many respects to the orthographic cue hypothesis proposed by Peressotti et al. (2003). According to their account, readers use information about the case of the first letter to constrain word recognition, possibly by selectively pre-activating word nodes for proper names. In support of this account, Peressotti et al. (2003) found participants were slower to respond to proper nouns presented in all lowercase (e.g., john, china, etc) than when they were presented with the first letter in uppercase (e.g., John, China, etc); this advantage of initial capitalisation was not observed for common nouns. Peressotti et al.'s account attributes this orthographic cue effect to a prelexical process, which is consistent with the effect observed in masked priming here. One difference between Peressotti et al.'s orthographic cue hypothesis and that proposed here, however, is that the cue posited by our account cannot be determined with reference to only the first letter – rather, it depends on both the first letter being uppercase and (at least one of) the following letters being lowercase. If only the first letter were critical it would be necessary to predict equivalent priming for titlecase and uppercase primes, both of which have the initial letter capitalised. This is not the pattern we observed, however.

Another difference concerns the locus of the orthographic cue effect. Peressotti et al.'s account attributes the orthographic cueing effect to recognition processes. While this locus is plausible, our account is more readily interpreted as attributing the orthographic cueing effect to decision processes. The claim is that, when participants are asked to decide, as rapidly as possible, whether a target stimulus is a name (as opposed to a familiar letter string) they make use of orthographic cues that are ordinarily reliably associated with names. If pre-activation of lexical representations for proper names is a viable mechanism (as in Peressotti's account) it seems at least as plausible to suggest that information about the case of the first letter could be used to prime a Brand (as opposed to Non-Brand) decision. This account explains not only the titlecase prime advantage in Experiment 3 but also the inhibitory effect of titlecase for pseudo-brand targets in Experiments 2 and 3; the latter effect cannot be fully attributed to priming of lexical representations, given that most pseudo-brands are not lexically represented, but is consistent with an orthographic cue being used to prime a Brand decision (inappropriately, in the case of pseudo-brands). A further prediction of the present account is that it may be possible to prime correct Brand decisions using unrelated primes, e.g., Rabbit-Google may lead to faster responses than rabbit-Google.

The results for pseudo-brands in our experiments include two findings that warrant further consideration. In Experiment 1 there was an interaction of Prime Type and Target Case, such that participants were faster to correctly reject a lowercase pseudo-brand when preceded by a lowercase identity prime than by an uppercase identity prime. As noted earlier, this phenomenon may be related to a similar observation that has been reported for nonword targets in a lexical decision task by Perea, Jiménez and Gómez (2014) and Vergara-Martínez, Gómez, Jiménez and Perea (2015). One possible explanation for the interaction of Prime Type and Target Case for

pseudo-brands is that it could reflect differences in the evidence accumulation process. For example, in the spatial coding model (Davis, 2010) it is assumed that decision accumulators are reset when the target onset is detected; in the situation where the prime and target are orthographically identical, same-case strings the system may be less likely to detect the transition from the prime to the target, so that the accumulation towards a No decision commences with the prime, rather than the target (the headstart in accumulation is less relevant to Yes decisions, as there is a slower build-up of lexical activity during initial processing of the prime). Similar accounts would follow from models of word recognition that incorporate a variable deadline (e.g., Coltheart, Davelaar, Jonasson & Besner, 1977; Grainger & Jacobs, 1996). Nevertheless, it must be noted that the interaction of Prime Type and Target Case was not observed in Experiment 3 or for the uppercase targets in Experiment 2, and hence it is prudent to be cautious concerning the interpretation of this effect.

The other pseudo-brand finding that warrants further consideration is the main effect of Prime Type observed for pseudo-brands in Experiment 2, with reaction times for identity primes showing an advantage over unrelated primes. A possible explanation suggested by one reviewer is that brand name recognition relies less strongly on orthographic processing than do other classes of words, and instead is driven by visual-logographic and phonological processes. Any identity priming due to activation of phonological representations will be invariant to case. According to this hypothesis, the impact of phonological factors may be greater for prime durations of 50 ms, as used in Experiments 2 and 3, compared to 33 ms prime durations used in Experiment 1 (see Ferrand & Grainger, 1994). However, there was a general trend showing a weak effect

of case for pseudo-brands in all three experiments, with case-matched identity primes giving an advantage of around 9 ms over case mismatched identity primes.

One might reason that some component of the observed priming effects for pseudo-brands is sublexical, since novel pseudo-brands presumably do not have lexical representations. However, it should be emphasized that that our pseudo-brands were deliberately designed to resemble brands, and like real brands, many were themselves real words (e.g., ready, relays, tanker etc.) or included embedded real words (e.g., utype, sungo, vitafuel etc.). It is also worth noting that lexical and sublexical priming effects need not be additive (see Forster, 1998; Sereno, 1991). For this reason, it is difficult to disentangle the factors that contributed to the priming effects for pseudo-brands in this study.

We used masked priming in the present studies because we wished to focus on early processing in visual word identification. As such, our results do not speak to the possibility that case-specific effects may be observed in post-identification processing. The existence of such effects seems to provide the most likely account of the case-specific effects that have been observed for brand names in single presentation decision tasks (Gontijo et al., 2002; Perea, Jiménez, et al., Exp 1, 2015). Perea, Jiménez et al.'s (2015, Experiment 1) finding of case sensitivity for brand names in a single presentation brand decision task is consistent with experiments that suggest that unusual case presentation (e.g., mixed case) occurs late in processing (e.g., Perea, Marcet & Vergara-Martínez, 2018; Perea, Vergara-Martínez & Gomez, 2015; Reingold, Yang & Rayner, 2010) and that the lowercase advantage for sentence reading occurs after lexical access

(Perea, Rosa & Marcet, 2017). More research is required to understand the nature and time-course of such putatively post-identification effects of case-specificity.

Nevertheless, for present purposes we note that such effects are not inconsistent with the canonical abstract account of word identification (but fall outside the scope of most of the specific models in this framework, though see, e.g., Besner, 1983 for an example of a model that does seek to capture effects of this sort).

Considerable sums are spent on branding (e.g., font, colours and case used in the brand name as well as icons and borders used in the logo), to make the specific form of the printed word uniquely recognisable, and on marketing to increase the word's familiarity. For this reason, brand names more than other words might be expected to be sensitive to deviations from their familiar format (e.g., font, colours or case). Our study does not directly address the question of how people recognise a brand's logo (e.g., specific arrangement including font, colours, case, border, images etc.), which may be different to typical word reading (i.e., more reliant on logographic and phonological information). The presentation of brand logos as targets (as opposed to presenting brand names in a standard font) may be a worthwhile line of inquiry in future research. Nevertheless, our findings on the effect of case provide important constraints on the extent of visually specific (as opposed to abstract) representations of brand names. Although a brand's logo may be the most familiar version of the brand name, it is very often the case that the brand name appears written in a generic colour and font, but with the specific case format preserved. Even in the absence of brand-specific font or colours, the case in which a word is presented should be a relatively salient deviation, given that it alters the wholistic word shape as well as the shape of the component letters. Nevertheless, our results suggest that the standard typographic form of a brand name is not relevant to the early stages of its recognition, at least when a standard font

and colour are used. Instead, our findings suggest that theories that posit that words are recognised on the basis of abstract letter codes can be applied to words that have a relatively invariable familiar wholistic shape, such as brand names (and presumably, by extension, proper nouns and acronyms).

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Table 1. Mean response times (in ms; standard error shown in parentheses) and percentage of errors for the brand names in Experiment 1.

Prime Case	Brand Target Case			
	Lowercase		Uppercase	
	RT	Error	RT	Error
Lowercase	641 (5)	5.03 (0.69)	640 (5)	5.13 (0.71)
Uppercase	644 (4)	4.31 (0.64)	646 (5)	5.77 (0.76)
Unrelated	685 (5)	6.92 (0.80)	683 (5)	9.93 (0.97)

Table 2. Mean response times (in ms; standard error shown in parentheses) and percentage of errors for the pseudo-brand names in Experiment 1.

	Pseudo-Brand Target Case			
	Lowercase		Uppercase	
	RT	Error	RT	Error
Prime Case				
Lowercase	685 (5)	2.82 (0.69)	707 (5)	4.61 (0.71)
Uppercase	696 (4)	2.52 (0.64)	699 (5)	4.10 (0.76)
Unrelated	706 (5)	1.88 (0.80)	698 (5)	4.51 (0.97)

Table 3. Mean response times (in ms; standard error shown in parentheses) and percentage of errors for the brand names in Experiment 2.

	Brand Target Case					
	Lowercase		Titlecase		Uppercase	
Prime Case	RT	Error	RT	Error	RT	Error
Lowercase	638 (6.23)	8.69 (1.03)	634 (5.43)	6.17 (0.77)	622 (5.05)	3.94 (0.61)
Titlecase	643 (6.63)	8.29 (1.01)	625 (5.64)	5.65 (0.73)	618 (5.44)	5.41 (0.71)
Uppercase	648 (6.52)	9.33 (1.06)	633 (5.50)	6.26 (0.77)	615 (5.52)	5.41 (0.71)
Unrelated	690 (5.99)	9.33 (1.06)	681 (5.35)	5.76 (0.74)	674 (5.24)	6.79 (0.79)

Table 4. Mean response times (in ms; standard error shown in parentheses) and percentage of errors for the pseudo-brand names in Experiment 2.

	Pseudo-Brand Target Case					
	Lowercase		Titlecase		Uppercase	
Prime Case	RT	Error	RT	Error	RT	Error
Lowercase	708 (6.24)	4.43 (0.65)	719 (5.98)	3.42 (0.59)	716 (5.86)	5.75 (0.72)
Titlecase	714 (6.09)	3.54 (0.58)	713 (5.95)	3.21 (0.58)	715 (6.03)	5.47 (0.7).
Uppercase	724 (6.52)	5.40 (0.71)	730 (6.31)	2.88 (0.55)	714 (6.06)	5.17 (0.69)
Unrelated	736 (6.14)	4.92 (0.68)	751 (6.07)	2.56 (0.52)	740 (5.77)	4.60 (0.65)

Table 5. Mean familiarity ratings (0-3) for questionnaire items in Experiment 2.

lowercase		Titlecase		UPPERCASE	
item	familiarity	item	familiarity	item	familiarity
adidas	2.64	Andrex	2.21	ALDI	2.14
always	2.01	Argos	2.41	AMSTEL	1.06
amazon	2.89	Audi	2.06	BACARDI	1.89
android	2.52	Boots	2.80	CASIO	1.64
attitude	0.14	Budweiser	2.18	CHANEL	2.12
audible	0.93	Canon	2.37	COSTA	2.85
bing	1.75	Carlsberg	2.25	DIESEL	1.68
carhartt	0.75	Cheerios	2.38	FIAT	2.03
dairylea	1.52	Colgate	2.85	FOSTER'S	2.34
durex	2.28	Disney	2.60	GUCCI	2.06
ebay	2.74	Doritos	2.47	HARIBO	2.55
evian	2.46	Dove	2.41	HEINZ	2.65
facebook	2.98	Emirates	2.04	HONDA	2.13
febreze	2.09	Fanta	2.44	IKEA	2.47
flickr	1.67	Ford	2.44	LEXUS	1.60
graze	1.86	Gillette	2.19	MARTINI	1.52
guardian	2.46	Google	2.98	MINI	1.97
halfords	1.74	Grolsch	0.60	NESCAFE	2.39
innocent	2.05	Guinness	2.09	NIKE	2.66
intel	1.89	Harvester	1.25	NISSAN	2.14
itsu	1.02	Heineken	2.32	NIVEA	2.49
megabus	1.75	Kellogg's	2.66	NOKIA	2.32
mentos	2.10	Lipton	1.93	OREO	2.68
myspace	1.52	Marlboro	1.84	PANTENE	2.40
next	2.45	Microsoft	2.84	PEUGEOT	2.18
nickelodeon	1.69	Nando's	2.65	PORSCHE	1.89
pepsi	2.59	Nesquik	1.94	PUMA	2.19
reddit	1.66	Nestle	2.27	ROLEX	1.72
revels	1.59	Orbit	1.04	RYANAIR	2.07
skype	2.58	Panasonic	2.25	SAMSUNG	2.58
smart	0.94	Persil	1.99	SMIRNOFF	2.61
smartwater	1.53	Pringles	2.60	SONY	2.37
swatch	1.29	Reebok	2.22	STARBUCKS	2.74
tinder	2.04	Sainsbury's	2.97	SUBWAY	2.68
twitter	2.70	Santander	2.47	TOYOTA	2.26
vitaminwater	1.52	Shreddies	2.16	VISA	2.83
vodafone	2.51	Superdrug	2.50	VOLVO	2.15
wagamama	2.53	Tetley	1.92	WALKABOUT	0.81
wonga	1.28	Weetabix	2.44	WALKERS	2.68
xerox	0.97	Zizzi	1.59	ZARA	2.47

Table 6. Mean response times (in ms; standard error shown in parentheses) and percentage of errors for the brand names in Experiment 3.

	Brand Target Case					
	Lowercase		Titlecase		Uppercase	
Prime Case	RT	Error	RT	Error	RT	Error
Lowercase	575 (5.26)	6.48 (.76)	587 (5.45)	8.18 (.84)	561 (4.45)	4.29 (.61)
Titlecase	566 (5.06)	7.61 (.81)	577 (5.16)	9.02 (.88)	557 (4.80)	4.29 (.61)
Uppercase	583 (5.28)	6.67 (.77)	590 (5.29)	9.49 (.90)	558 (4.90)	5.00 (.65)

Table 7. Mean response times (in ms; standard error shown in parentheses) and percentage of errors for the pseudo-brand names in Experiment 3.

	Pseudo-brand Target Case					
	Lowercase		Titlecase		Uppercase	
Prime Case	RT	Error	RT	Error	RT	Error
Lowercase	599 (5.31)	0.05 (.66)	623 (5.23)	0.04 (.60)	609 (5.23)	0.04 (.62)
Titlecase	599 (5.26)	0.04 (.60)	616 (5.54)	0.03 (.52)	612 (5.37)	0.04 (.62)
Uppercase	610 (5.31)	0.04 (.62)	617 (5.33)	0.04 (.60)	605 (5.51)	0.04 (.59)

Appendix A: Items used in Experiment 1

Brands:

Uppercase: ALDI, FIAT, IKEA, LEGO, MINI, NIKE, OREO, PUMA, SONY, VISA, ZARA, CASIO, COSTA, GUCCI, HEINZ, HONDA, LEXUS, NIVEA, NOKIA, ROLEX, TESCO, VOGUE, VOLVO, CHANEL, DIESEL, DOLMIO, HARIBO, NISSAN, SUBWAY, TOYOTA, YAMAHA, BACARDI, L'OREAL, MARTINI, NESCAFE, NETFLIX, PANTENE, PEUGEOT, PHILIPS, PORSCHE, RENAULT, RYANAIR, SAMSUNG, SIEMENS, WALKERS, BARCLAYS, FOSTER'S, SMIRNOFF, SNICKERS, VAUXHALL, STARBUCKS

Lowercase: (* marks *all-lowercase* items) Audi, Dove, ebay*, Ford, Mars, next*, Twix, Argos, Boots, Canon, durex*, evian*, Fanta, pepsi*, skype*, adidas*, amazon*, Andrex, Disney, Google, Lipton, Nestle, Persil, Reebok, Tetley, Colgate, Doritos, Nando's, Nesquik, Spotify, Cheerios, Emirates, facebook*, Gillette, Guinness, Heineken, Marlboro, Pringles, Skittles, Weetabix, Budweiser, Carlsberg, Instagram, Kellogg's, Maltesers, Microsoft, Morrisons, Panasonic, Santander, Shreddies, Superdrug

Pseudo-brands:

Uppercase: ALME, PIAL, IFUA, TOLA, WIZI, MIRE, OKAO, PONA, SUBY, MESA, ZEPa, COSBO, CATSO, CAGGI, HAILZ, HUNDI, LOKAS, MOVIA, VORIA, RULEZ, LASCO, ROQUE, MOLMO, CHOMOL, DAMSEL, PALMIA, MONIDO, MISSEM, SALARY, TAGATA, TANAKA, BAPANDI, J'AURLE, NANTIZI, MOSGATE, WEBTRIX, BENTINE, PEACOAT, BRILIDS, BANSCHÉ,

SAMOULD, RUNGEAR, SINAGOG, REINERS, WORKERS, DARKLOTS,
FUELER'S, SUNPROOF, SWINICKS, FAUXCELL, STORLOCKS

Lowercase: (marks, all, lowercase, items)* Anbi, Daze, utoy*, Rond, Hans,
maxt*, Priz, Angas, Boals, Cones, berax*, eriac*, Forto, jogsi*, utype*, obidos*,
amazed*, Ardnox, Besmag, Ceegle, Loglar, Mastle, Pensit, Boodoh, Tubley, Catgale,
Bosidos, Mandu's, Makpesh, Rospity, Chocinom, Eminales, fonedart*, Cibbelle,
Coinness, Harishan, Northaro, Pingless, Skippies, Woolchox, Dubmainer, Corlatany,
Prontopic, Hattagg's, Branflirt, Minorsalt, Hossicons, Duranomic, Sortonden, Sharkkies,
Sugartang

Appendix B. List of stimuli used in the Experiment 2.

Brands:

Lowercase: adidas, always, amazon, android, attitude, audible, bing, carhartt, dairylea, durex, ebay, evian, facebook, febreze, flickr, graze, guardian, halfords, innocent, intel, itsu, megabus, mentos, myspace, next, nickelodeon, pepsi, reddit, revels, skype, smart, smartwater, swatch, tinder, twitter, vitaminwater, vodafone, wagamama, wonga, xerox.

Titlecase: Andrex, Argos, Audi, Boots, Budweiser, Canon, Carlsberg, Cheerios, Colgate, Disney, Doritos, Dove, Emirates, Fanta, Ford, Gillette, Google, Grolsch, Guinness, Harvester, Heineken, Kellogg's, Lipton, Marlboro, Microsoft, Nando's, Nesquik, Nestle, Orbit, Panasonic, Persil, Pringles, Reebok, Sainsbury's, Santander, Shreddies, Superdrug, Tetley, Weetabix, Zizzi.

Uppercase: ALDI, AMSTEL, BACARDI, CASIO, CHANEL, COSTA, DIESEL, FIAT, FOSTER'S, GUCCI, HARIBO, HEINZ, HONDA, IKEA, LEXUS, MARTINI, MINI, NESCAFE, NIKE, NISSAN, NIVEA, NOKIA, OREO, PANTENE, PEUGEOT, PORSCHE, PUMA, ROLEX, RYANAIR, SAMSUNG, SMIRNOFF, SONY, STARBUCKS, SUBWAY, TOYOTA, VISA, VOLVO, WALKABOUT, WALKERS, ZARA.

Unconventional case: BlackBerry, BuzzFeed, CBeebies, DreamWorks, easyJet, FedEx, GoPro, HoVIS, iPlayer, iTunes, KitKat, MasterCard, MasterChef, McDonald's, McVitie's, NUTRiBULLET, PayPal, TopGear, WHSmith, YouTube.

Pseudo-brands:

Lowercase: affected, amazed, apogees, artiflo, berax, citruscooler, cooltard, crutch, diarytac, eriac, fabzone, fonedart, halfcabs, hong, ifca, jogsi, martes, maxt, napacoco, nusole, obidos, onlet, partisan, proze, raddot, ready, relays, roxon, silverfilms, snackmeals, sungo, supatea, tanker, trickl, tuittor, utoy, utype, vehicle, virtuous, vitafuel.

Titlecase: Anbi, Angas, Ardnox, Besmag, Boals, Boodoh, Bosidos, Catgale, Ceegle, Chocinom, Cibbelle, Coinness, Cones, Corlatany, Daze, Dubmainer, Duranomic, Eminales, Forto, Harishan, Hattagg's, Hereunder, Loglar, Makpesh, Mandu's, Mastle, Minorsalt, Northaro, Onbil, Pensit, Pingless, Quelock, Rond, Seinsberg's, Sharkkies, Sortonden, Sugartang, Tubley, Vivva, Woolchox.

Uppercase: ALME, ASHTOL, BANSCHÉ, BAPANDI, BENTINE, CAGGI, CATSO, CHOMOL, COSBO, DAMSEL, FUELER'S, HAILZ, HUNDI, IFUA, LOKAS, MESA, MIRE, MISSEM, MOLMO, MONIDO, MOSGATE, MOVIA, NANTIZI, OKAO, PEACOEAT, PIAL, PONA, RULEZ, RUNGEAR, SALARY,

SINAGOG, STORLOCKS, SUBY, SUNPROOF, TAGATA, VORIA, WIZI,
WORKADAPT, WORKERS, ZEPA.

Unconventional case: artiBot, BigCorn, BrushBunny, BuyBet, CHackers,
CyClo,, DriveWoods, FabAc, FarmerBook, HotHut, iBlogger, iFarms, MarketShed,
MoVES, MyBuddie's, MyVoter's, PussFood, SNOWiCHALET, TheDude, WINarch.

Appendix C. List of stimuli used in the Experiment 3.

Brands:

Lowercase: adidas, amazon, android, bing, durex, ebay, evian, febreze, flickr, graze, mentos, next, nickelodeon, pepsi, reddit, skype, tinder, twitter, vodafone, wagamama.

Titlecase: Andrex, Argos, Audi, Budweiser, Disney, Doritos, Emirates, Gillette, Google, Guinness, Heineken, Kellogg's, Lipton, Nando's, Nesquik, Panasonic, Persil, Pringles, Reebok, Tetley.

Uppercase: ALDI, CHANEL, COSTA, FOSTER'S, GUCCI, HEINZ, HONDA, IKEA, NESCAFE, NIKE, NOKIA, OREO, PORSCHE, ROLEX, SAMSUNG, SONY, STARBUCKS, TOYOTA, VOLVO, WALKERS.

Pseudo-brands:

Lowercase: abehos, ambirod, ameran, bony, danax, eriac, eudy, fabzone, floten, growz, mintie, neot, noodleedoon, poggi, runtab, slygo, tanker, trakken, vitafuel, wapacoco.

Titlecase: Anbi, Angas, Ardnox, Bulmainer, Datores, Dimsoy, Eminales, Gattolle, Gennuiss, Goaley, Harishan, Kottege's, Loglar, Mandu's, Nospeik, Pensit, Ponytree, Puronamic, Roukoh, Toptip.

Uppercase: ALME, CATSO, CHOMOL, FUELER'S, GEOGI, HAILZ, HAMBO, IFUA, NEDEU, NOSGATE, NURO, OKAO, PANASCH, RULEZ, SEOSMUG, STORLOCKS, SUBY, TAGATA, VORIA, WORKERS.